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Cedar Apple Rust and Its Control

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A Dangerous Situation
Cedar Trees growing near Apple Trees

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CEDAR APPLE RUST AND ITS CONTROL

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There are three distinct species of fungi that are frequently associated with the disease commonly referred to as cedar apple rust. Provisions are made in our regulations for the control of **Gymnosporangium juniperi-virginianae** Schw., **G. germinale** (Schw.) Kern and **G. globosum** Farl. While the life cycle and the nature of the infection of these diseases are somewhat different, recommended control measures are the same for each disease. Reference will therefore be confined to the disease caused by **Gymnosporangium juniperi-virginianae** Schw., which is the one most frequently found in our Pennsylvania orchards.

ALTERNATE HOST DISEASE

Cedar apple rust, caused by **Gymnosporangium juniperi-virginianae** Schw., is a fungous disease with a very interesting but rather complex life history and a scientific name that is somewhat confounding. As the name implies, cedar apple rust is an alternate host disease; alternate in that it passes a part of its life on the common red cedar (**Juniperus virginiana** L.) and part on the apple and such plants as the wild crab before it completes its life cycle. This interesting but destructive disease is quite common in Pennsylvania, especially in areas where apple and cedar trees are allowed to grow in close proximity to each other. Under these conditions, severe infections are frequently established and accompanied by serious losses to the fruit grower.

It requires two years for this fungus to complete its life cycle. The fungus spores pass back and forth regularly from one host to the other. It spends one summer on the apple and approximately a year and a half on the cedar before the cycle is complete and ready to be repeated.

Spore infection from the cedar to the apple takes place during the spring months. Under conditions as they exist in Southeastern Pennsylvania, where the disease is most frequently found, infection probably takes place during April and early May. The spores are wind-blown and may, under favorable conditions, be carried for several miles from the cedar to the apple, where they are deposited on the young leaves and fruit. This spring spore infection is the beginning of the summer stage, which the fungus spends on the apple.

SYMPTOMS ON THE APPLE

About four weeks after infection of the young apple leaves a dark brown area appears on the upper surface. Later in the summer, as the fungus continues to develop, this spot becomes darker or almost black, with a larger orange-yellow surrounding area. The margin of this yellow area sometimes develops an orange-red color and, on the under side of the leaf where the rust spot appears, raised cup-shaped dusty-brown fruiting bodies may be found. (Figure I). These fruiting bodies, when mature, split open and tend to curl outward, thus releasing a new crop of spores.

Fig. I. Apple leaves infected with the cedar apple rust fungus.

On the fruit, rust spots usually appear around the calyx, although infection may sometimes be found on other parts of the apple. These spots, when they are mature, show the same kind of fruiting bodies that appear on the under side of the infected leaf. The centers of these spots show the same dusty-brown cup-like structures which split open as they do on the leaf (Figure II). This

stage is usually reached during August and early September on both the leaf and the fruit and produces the spores which are carried by the wind to the cedar, where infection again takes place.

SYMPTOMS ON THE CEDAR

Symptoms of the disease do not become apparent, however, on the cedar until toward the middle of the following summer, when small shiny brown gall-like growths usually appear on the small outer branches. At first these galls are not much larger than a pinhead but may develop to two inches or more in diameter by the following spring. As these galls develop they take on a purplish-brown cast and while they are dormant they show numerous small depressions, with the center of the depression slightly raised by the time they reach their full size (Figure III). These cedar galls

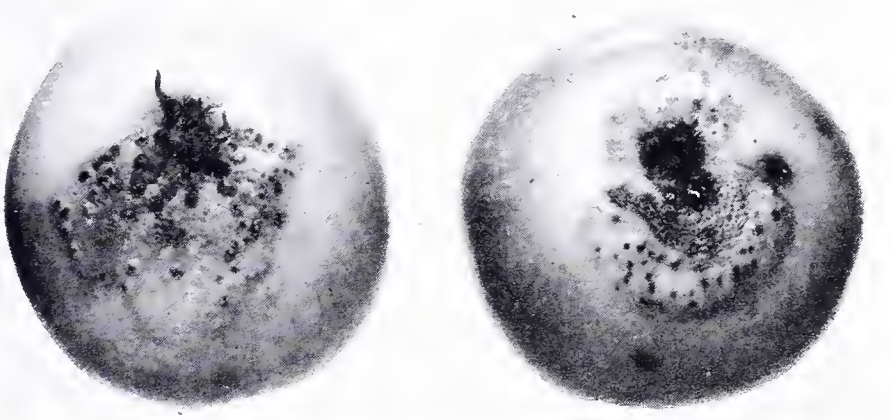

Fig. II. Cedar rust on apples.

are sometimes quite numerous and can be readily observed if the infection is heavy.

The same conditions of temperature and moisture that cause plants to start growth in the spring will also start activity in the cedar galls. From the small depressions on these galls there are produced finger-like projections called spore-horns (Figure IV). These spore-horns may reach an inch in length and usually emerge after a day of rain following a short period of warm, balmy spring weather. When moist, the spore-horns appear as bright orange-colored gelatinous-like masses, changing to a dark brown color after they become dry. They are the fruiting bodies of the fungus on the cedar and produce the spores that reinfect the young leaves and fruit of the apple, thus completing the life cycle of the fungus.

LOSSES TO THE FRUIT GROWER

Losses to the orchard owner as a result of this disease are brought about through a reduction in the available healthy foliage and through injury to the fruit.

Fig. III. Cedar galls on the common red cedar.

Foliage infection is sometimes so severe that it is impossible to find an area one-quarter inch square of healthy tissue on an infected leaf. Infections of this kind cause the leaf to turn yellow and drop

prematurely. A report was received where a tree was so badly infected that it lost all its foliage prematurely and developed a new set of leaves late in the summer. Rust infection frequently reduces the useful leaf surface to a fraction of its normal area. Any reduction in the normal healthy leaf tissue of a fruit tree not only hinders the development of the fruit crop but also the growth of the tree. Trees with badly infected foliage seldom produce anything but small undersized fruit which must be sold at a considerable loss to the grower.

While fruit infection is usually not so extensive as foliage infection, infected fruits are frequently a total loss to the grower since the spots on the fruit usually remain green and unripened for some distance around the infected area.

SUSCEPTIBILITY OF APPLE VARIETIES

In addition to the interesting and fascinating life cycle of the cedar apple rust disease, it is of more than passing interest to note the difference in the susceptibility to infection of the various apple varieties to this fungus. We have found, during our cedar apple rust control work throughout the State, that a number of varieties were rather highly susceptible to foliage infection. These varieties, in order of susceptibility as we found them, are York, Smokehouse, Rome Beauty, Summer Rambo, Jonathan, Grimes Golden, Wealthy, Stayman and Red Delicious. Other varieties that we found with foliage infection but are thought to be somewhat resistant to foliage infection were the Belleflower, Ben Davis, Black Twig, Gano, Golden Delicious, Gravenstein, Hubbardston, King, Maiden Blush, Pippin, Smith Cider, Stark, Wagener and Yellow Transparent. These varieties in some cases showed only a trace of infection and in no instance was the loss from the disease as heavy as was found on those varieties that are given as being highly susceptible. Since these somewhat resistant varieties also occurred less frequently in our orchards, it is possible that, if they were found more frequently and were exposed to more varying conditions during the period of infection, some of them might prove to be more susceptible.

Severe fruit infection was found on the Smokehouse, Rome Beauty, Wealthy and Jonathan, while the Belleflower, Ben Davis, Black Twig, Gano, Hubbardston, Stark, Stayman and York and a few other less prominent varieties showed only slight infection. The fruit of the York Imperial showed a high degree of resistance to the fungus and, from the number of orchards in which we found this variety, we have reason to believe that it is highly resistant

to fruit infection but not entirely immune to the rust disease. Some of the other varieties that showed only slight fruit infection might also prove to be more susceptible if exposed to infection during the period when infection is most likely to occur.

No fruit or foliage infection was found on Baldwin, Northern Spy, Red Astrachan or Winter Banana. We have reports, however, of its having occurred on several of these varieties in some of our Pennsylvania orchards.

CONTROL

The Bureau of Plant Industry has given attention for a number of years to the control of cedar apple rust. The removal of red cedar trees from areas adjoining apple orchards in order to protect the orchard against the disease has been a recognized practice in other States as well as in Pennsylvania for many years. Spraying fruit trees for the control of this disease has proven to be of doubtful value while eradication of the cedar has given excellent results.

From our observations we believe that, under favorable conditions, spore infection from the cedar may carry for a distance of approximately three miles to the apple. On the other hand, growers have secured satisfactory control by removing the cedar trees around an orchard for a distance of a mile or even less, depending on the topography and other physiological conditions in relation to the orchard. The most severe infections, of course, occur where the cedar and apple are growing in close proximity to each other. As the distance between the cedar tree and apple increases, the severity of the infection becomes less. Where prevailing winds blow from the cedar to the apple during the spring infection period and the topography of the country is level and open to gently rolling, the cedars should be removed for a distance of approximately a mile from the orchard.

Under our eradication program even the smallest seedling, which may only be a few inches high, must be cut or removed. We have record of an orchardist who was experiencing serious losses from cedar apple rust and who believed that the infection came from cedar trees located more than three miles from his orchard. Upon investigation it was found that his trees were severely infected but that the infection was coming from a small cedar tree less than 18″ high along a fence row in the corner of his orchard. The tree was literally covered with cedar galls.

TABLE I

CEDAR APPLE RUST DISEASE CONTROL DATA*

Project Number	Number of Apple Trees in Orchard	Varieties Infected	Per Cent Infection on Apple Before Cedars Were Removed		Number of Cedars Removed
			Foliage	Fruit	
290	9,000	Rome	20.0	10.0 to 20.0	
		Jonathan	0.0	2.0	
		Grimes	40.0	1.0	
		Stayman	0.0	1.0	
					1,213
291	2,000	York	100.0	None	
		Smokehouse	100.0	Trace	
		Summer Rambo.	Trace	None	
					90
285	338	York	6.0	None	
		Jonathan	2.0	0.5	
					15,153
286	3,525	Stayman	No record	10.0	
		Delicious	" "	Trace	
		Wealthy	" "	10.0	
		Smokehouse	" "	10.0	
		Rome	" "	Trace	
		Red Stark	" "	5.0	
		Duchess	" "	Trace	
		Summer Rambo.		17.0	
					935
288	800	Delicious	None	3.3	
		Stark	2.0	4.6	
		York	9.5	2.0	
		Stayman	None	1.5	
		Hubbardston	"	2.0	
		Jonathan	13.0	4.0	
		Black Twig	None	3.5	
		Akin	"	6.5	
					100
289	4,500	Rome	None	8.0	
		Gano	"	4.0	
		York	12.0	2.0	
		Jonathan	18.0	2.5	
		Belleflower	None	3.5	
		Black Twig	"	5.0	
		Stayman	1.0	2.0	
		Wealthy	6.0	5.5	
					12

Table I gives information on a number of typical orchards which were protected from the cedar apple rust disease by eradicating the cedar trees in the vicinity of the orchards. Frequent inspections of the orchards since the cedar trees were removed revealed only a trace of the disease on either the fruit or foliage in the various orchards.

*Trace equals less than one-tenth of one per cent.

It has been suggested, as another means of controlling this disease, that where the cedar is a valuable ornamental, control may be secured by removing the galls from the cedar tree. This was attempted in a few isolated instances but was finally abandoned as a hopeless task for several reasons: 1, It is almost impossible to find the small galls that are sometimes scarcely larger

Fig. IV. Cedar gall in the spore-producing stage, showing spore-horns.

than a pinhead. 2, Where cedars have an ornamental value they are usually rather large trees, which adds to the difficulty of locating the galls. 3, Since the cedar leaves are rather prickly, persons who have attempted the task of hunting and removing the cedar galls soon lost their aesthetic viewpoint toward the

cedar and readily remove the trees, regardless of ornamental value.

The removal of cedar trees for a distance of approximately a mile around an orchard will not give 100% control of the cedar apple rust disease. Orchardists have found, however, that fruit and foliage infection can be reduced to a point where no appreciable economic loss will occur. Table I, shows how trees that showed 100% foliage infection before the removal of the cedars, revealed only traces, or less than 0.1% of infection after their removal. Fruit growers report highly satisfactory results with this method of control.

Any person desiring a copy of the rules and regulations providing for the valuation and eradication of red cedar trees as a protection to apple orchards against the several cedar apple rust diseases known as **Gymnosporangium juniperi-virginianae** Schw., **G. germinale** (Schw.) Kern and **G. globosum Farl.**, can secure a copy by writing to the Pennsylvania Department of Agriculture.